1 **4.10. Risk Management (Satisfies iCMM process area 13 criteria)**

2 **4.10.1. Introduction to Risk Management**

3 The Perform Programmatic Risk Management process (Figure 4.1-10) provides an organized,
4 systematic decisionmaking process that identifies risks to achieving program/project goals,
5 analyzes these risks, effectively mitigates them, and tracks the progress of mitigation efforts.
6 Programmatic Risk is defined as an event or situation with a realistic (non-zero and not 100%)
7 likelihood/probability of occurring and an unfavorable consequence/impact to the successful
8 accomplishment of the well-defined program goals should it occur. The process should be
9 applied at all levels, from small projects to large programs, and should be applied continuously
10 throughout the program's lifecycle looking at all aspects of the program (see Figure 4.10-2).
11 The risks must also be "rolled up" from a project or several projects to a program. Risk roll-up
12 involves a review of the consequences/impacts from a higher (program) level. The risks to
13 meeting the objectives or benefits of these projects or programs are typically known as
14 programmatic risks. This process complies with the requirements of the iCMM (Process Area
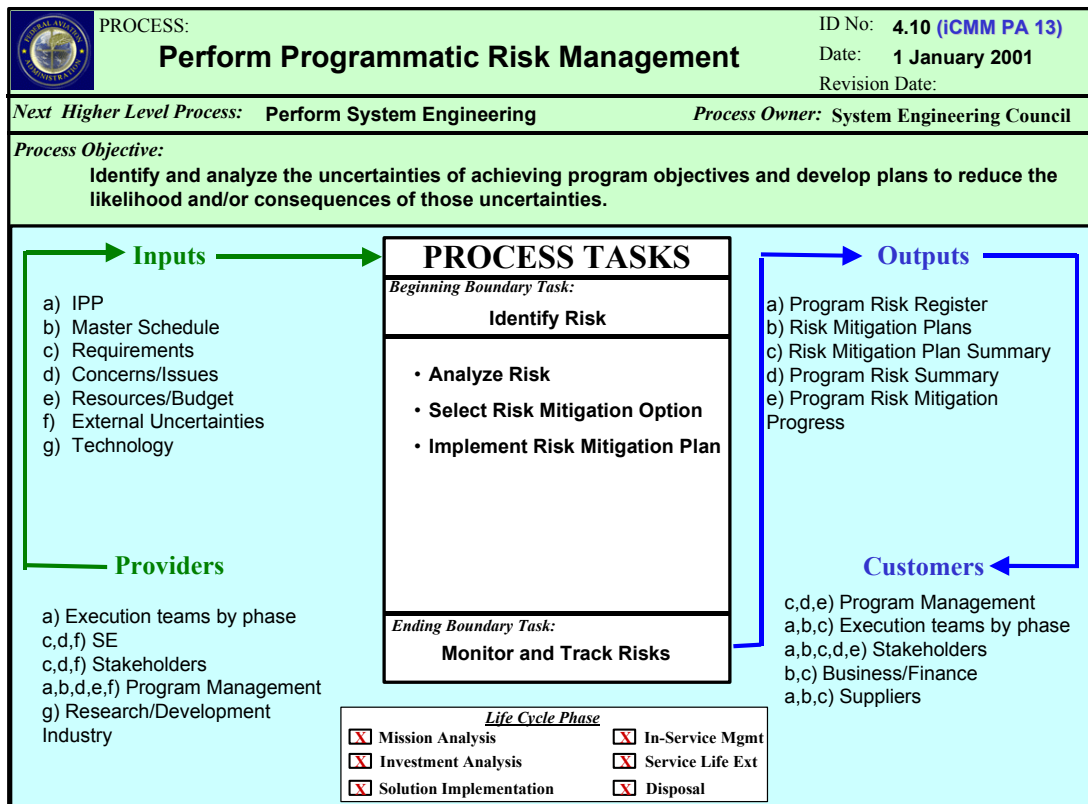15 13). It also satisfies EIA 632 requirement 24 and EIA 731 Focus Areas 2.5-2 through 2.5-8.

16

17
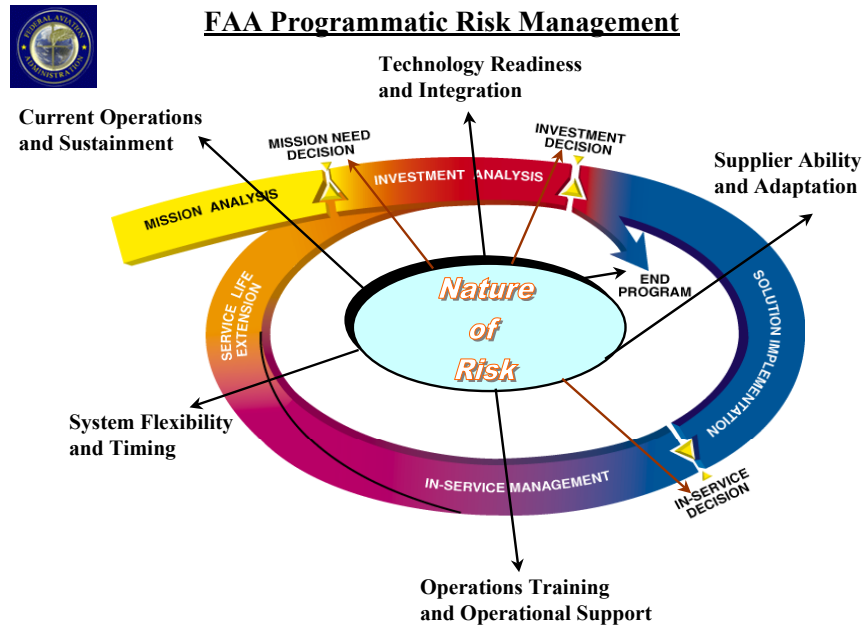18 **Figure 4.10-1. Risk Management Process-Based Management Chart**

19
20
21

FAA Programmatic Risk Management

22

23   **Figure 4.10-2.**

24

25   **4.10.1.1. Function of Risk Management**

26   Programmatic risk management is a basic system engineering element of successful program
27   management (Figure 4.10-3). When properly executed, Risk Management engages all
28   disciplines and execution teams and is present in all program stages/phases. The functions
29   (Figure 4.10-4) of the process are to:

30   • Identify each risk to the program

31   • Analyze and assess the negative consequences/impact and the likelihood/probability of
32   the risk actually occurring and determine risk resolution date

33   • Develop specific approaches and plans that will mitigate the risk

34   • Implement the risk mitigation plan

35   • Monitor and track risk mitigation effectiveness

36   Based on results from these functions, program management can then determine:

37   • The amount of schedule and budget reserves that should be allocated and to what,
38   based on identified risks

39   • How to measure overall program performance with respect to each risk

40   • How much and what type of help will be needed from other sources

41   • When to look at the process to see if the mitigation effort is working

42   • When to add mitigation efforts, costs, and milestones to program master schedule and
43   budget

44

45

FAA Programmatic Risk Management
Risk In System Engineering
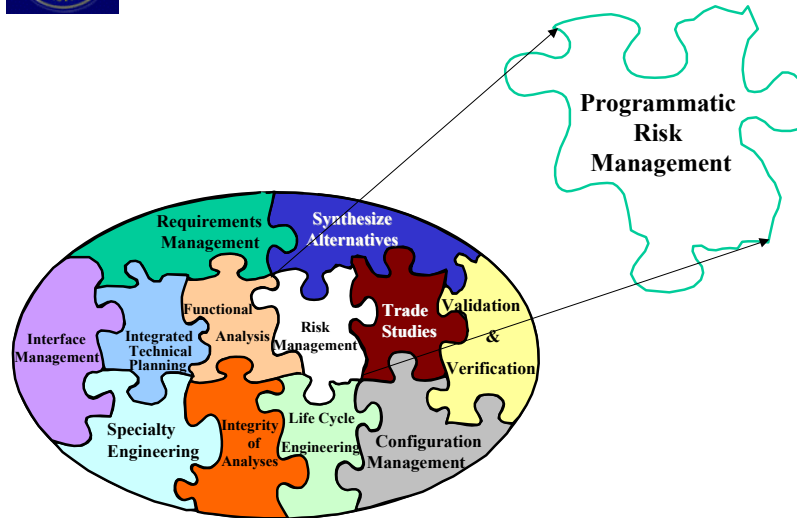

46

47

48

Figure 4.10-3.

FAA Programmatic Risk Management

Risk: A situation or circumstance which creates uncertainties about achieving program objectives.

Risk Management: An organized, systematic decision-support process that identifies risks, assesses or analyzes risks, and effectively mitigates or eliminates risks to achieving program objectives.
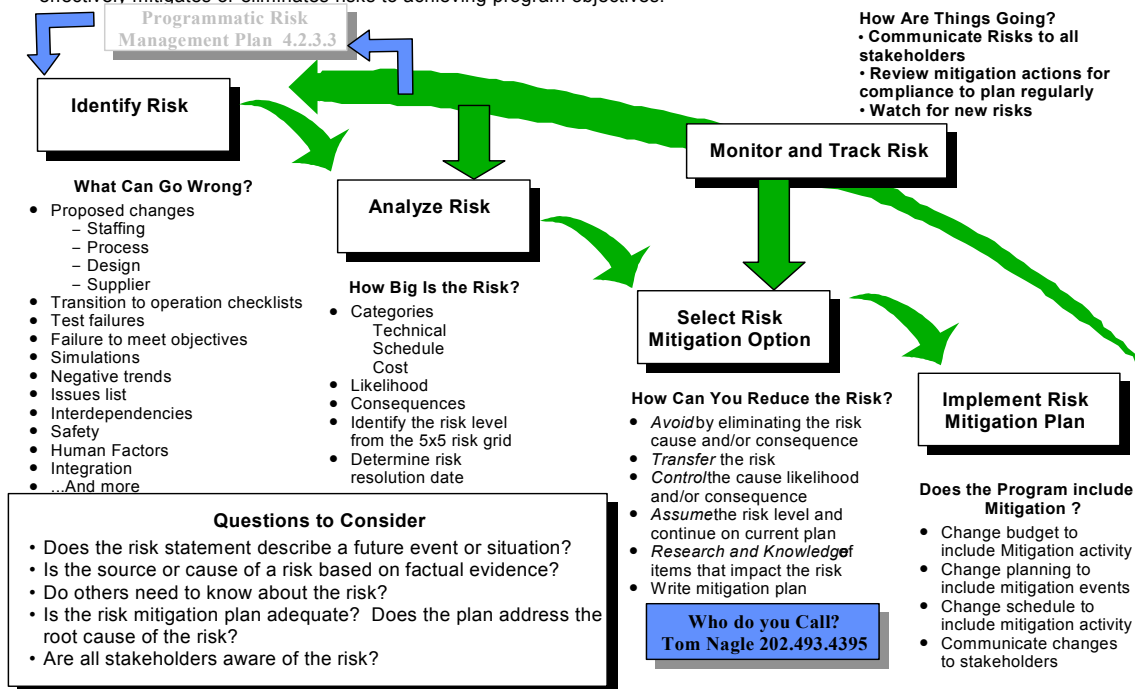

49

50

Figure 4.10-4.

51   **4.10.1.2. Risk Management Objectives**

52   The fundamental objective of the Programmatic Risk Management process is to identify and
53   analyze uncertainties of achieving program objectives and develop plans to reduce the
54   likelihood and/or consequences of those uncertainties.

55   This process is applied to ensure that a program meets technical, schedule, and cost
56   commitments; delivers a product that satisfies all stakeholders' lifecycle needs; and provides the
57   expected benefit. Four lower-level objectives are established as part of meeting the overall
58   objective:

59   • Timely identification of risks (identifying a potential problem with sufficient leadtime so
60   the team can implement appropriate alternate plans)

61   • Consistent assessment of the level of risk across a program (providing a structured
62   decisionmaking framework for prioritizing resource application)

63   • Communication of risk mitigation actions across the program/project (ensuring that all
64   elements of the program/project are aligned in resolving risks)

65   • Review of risk mitigation action performance.

66   **4.10.2. Risk Management Process Description *(Satisfies iCMM PA-14, BP13.04 criteria)***

67   Every participant in a program/project shares in the responsibility of assessing and mitigating
68   risks. This process is a part of the overall program/project management and system
69   engineering process. The process must be aligned with the individual products (hardware,
70   services, and software) that result from consistent functional analysis and requirements
71   allocations, the Integrated Program Plan (IPP), the master schedule, the associated funding,
72   and the identified goals and benefits. The program is assessed as to risks associated with
73   impacts on program benefits, interdependent programs, or environments. For each product,
74   risks are evaluated against the acquisition baseline technical requirements, schedule, and cost,
75   leading to the successful satisfaction of the program objectives. Risks are identified and
76   assessed, and appropriate risk mitigation actions are established that comply with the
77   program/project risk management plan within the IPP (see Section 4.2.2.2 in Integrated
78   Technical Planning (Section 4.2)). This plan is developed and tailored (when the technical
79   nature of the program demands tailoring) to satisfy specific program/project needs. *(Satisfies*
80   *iCMM BP 13.01 criteria)*

81   Results from each assessment are a starting point for the risk mitigation plan to support
82   program management decisions (technical, schedule, and cost). The products of this process
83   are also shared with stakeholders to achieve alignment/acceptance of the resource decisions.
84   All risks are examined at each program/project/event/item/peer review as defined in the risk
85   management plan. Updates will reflect changes in risk resulting from planned mitigation
86   activities or other unplanned events. Risk progress is actively tracked. For each risk, a "risk
87   resolution date" (RRD) is established, marking the event at which either the risk no longer exists
88   or when the program must be modified to accommodate the negative consequences. The
89   question **must** be asked and answered: "What happens on this date?" Risk is "rolled up" when
90   it is taken from a lower-level project to a higher-level program.

91   An essential element of the Programmatic Risk Management process from an organizational
92   point of view is the non-advocate concept. The purpose of a non-advocate is to provide an
93   impartial, objective assessment of the project team's results, especially with respect to the
94   assignment of risk levels. The input of a non-advocate is essential on those projects where two
95   or more of the project specialists disagree on the risk levels. A non-advocate would typically be,
96   but not be limited to, a program management person (above or at the same level of the

97   program/project manager), a stakeholder representative, and/or a person from another project
98   or program. The responsibility of a non-advocate is to examine and assess all aspects of the
99   program/project risk management process before each review. For small projects, one or two
100   non-advocates may be acceptable. A non-advocate will provide an assessment to
101   program/project managers for consideration and action.

102   **4.10.2.1.Overview**

103   The top-level process for Programmatic Risk Management is shown in Figure 4.10-1. The
104   process includes steps that result in the identification of potential risks, analysis and
105   assessment of risk, development of risk mitigation plans, implementation of the Risk Mitigation
106   Plan, and monitoring of risk status. The process is iterative and is used across the program
107   throughout the program's lifecycle, with the nature of the risks changing to coincide with the
108   lifecycle stage.

109   **4.10.2.2.Inputs to Risk Management**

110   The inputs required to initiate Programmatic Risk Management include both program/project-
111   and product-related data as shown in Table 4.10-1. Many of these inputs are developed and
112   refined through the continuous, iterative use of other system engineering processes. Each item
113   in the table is to be evaluated for resultant program risk.

114   **Table 4.10-1. Inputs to Risk Management**

Input	Reference
Requirements Documents	4.3.3
Integrated Program Plan (IPP)	4.2.1
System Engineering Management Plan (SEMP)	4.2.3.2
Risk Management Plan	4.2.2.2
Analysis Integrity Criteria	4.9.5.5
NAS Architecture	4.5.5
Trade Study Report	4.6.1.4
Design Analysis Report	4.8.4.3
Controlled Data and Reports	4.11.8
Contract	
Product Configuration Data	4.11.3
Acquisition Program Baseline (APB)	FAST
Acquisition Reviews	
Specialty Engineering Reports	4.8
Interfaces	
Test Plans and Reports	
Manufacturing/Production Information	
Resources/Budgets	
External Uncertainties	
Technology	
Acquisition Strategy Paper	

Input	Reference
Mission Need Statement (MNS)	
Concept of Operations (CONOPS)	
AMS Documents	
Technical Analysis	
Contractor Outputs	
Statement of Work (SOW)	
Verification Results	4.12
Training Results	
Maintenance Results	
Lessons Learned	FAST
Operational Results	
Safety Assessments	
Security Assessments	
Human Factors Assessments	
Integrated Master Schedule (IMS)	
Program Review Results	
System Safety Program Plan	4.8
LMS Documentation	

115

116 **4.10.3. Risk Management Process Tasks**

117 The Programmatic Risk Management process is summarized in Figure 4.10-1. The major
118 process steps shown in Figure 4.10-4 are described in the remainder of this section.

119 **4.10.3.1. Task 1: Identify Risk** *(Satisfies iCMM BP 13.02 criteria)*

120 Risk identification includes examining a program/project and documenting potential risks in the
121 areas of technical, schedule, and cost. Risk identification must be performed during each stage
122 of the program or whenever significant changes occur in plans or program status.
123 Circumstances requiring risk assessments include:

124 • Programmatic changes

125 • Unfavorable trends in Technical Performance Measures (TPMs) and predicted system
126   performance, schedules, and financial status

127 • Design/program/peer reviews

128 • Change proposals (including proposed changes in requirements)

129 • Occurrence of a major unforeseen event

130 • Newly identified risks

131 • Special assessments at the direction of agency management

132 • Changes or risks in interdependent programs

133 • Environment changes

134 As shown in Figure 4.10-1, participants in risk identification include all stakeholders, users,
135 suppliers, and appropriate members of execution teams. Teams will consider all likely risk
136 sources in identifying potential risks to the program/project. Risk identification is based on the
137 current program/project goals supported by the associated technical, schedule, and cost
138 requirements and plans.

139 A programmatic risk has two aspects: (1) the likelihood/probability that an event will occur and
140 (2) an unfavorable consequence/impact should it occur. The likelihood that a risk will occur
141 should not be so low as to be negligible (i.e., probability essentially equal to zero) nor should it
142 be equal to one, typically indicating that it has, in fact, already been realized. A risk must also
143 have a negative consequence/impact if realized. Positive consequences are not considered in
144 the FAA risk identification and analysis process; these are considered opportunities. Note that if
145 there is no uncertainty (i.e., the situation or circumstance is certain to occur or has already
146 occurred), there is no risk, even though the item has an unfavorable consequence. This
147 situation should be handled as a management issue, for which a corrective action plan must be
148 generated and implemented. This essentially requires a rebaselining of the program or possibly
149 cancellation of the program if the negative consequences are too severe.

150 Each risk must have a "risk resolution date." This is a date when either the risk no longer exists
151 or when the program must be modified to accommodate the negative consequences. This date
152 must be documented when the risk is identified. The question **must** be asked and answered:
153 "What happens on this date?" The negative consequence of the outcome of the event that
154 occurs on the given date is the basis for the risk.

155 **4.10.3.1.1. Potential Sources of Risk**

156 Risks originate from three basic areas—technical, schedule, and cost. A risk identification flow
157 is shown in Figure 4.10-5. Technical risk is based upon the likelihood that the program as
158 planned will be unable to deliver a product to satisfy the technical requirements. As such, well-
159 documented, defined, and quantified technical requirements are necessary to define a technical
160 risk. Most of the risks listed in Table 4.10-2 will be technical risks. Schedule risk results from
161 the likelihood that the program actions cannot be accomplished in the planned program timing.
162 A detailed program schedule identifying each accomplishment and the critical path is necessary
163 to develop schedule risks. Cost risk results from the likelihood that the program will not
164 accomplish planned tasks within the planned budget. A detailed budget, in which the cost of
165 each accomplishment is specified and any management reserve is known, is needed to
166 determine a cost risk. Potential loss of funding is not a programmatic risk in this risk process.
167 Within the FAA risk process, *cost* is the ultimate expenditure required for a resource and the
168 end product produced by that resource. *Budget* is the forecast of all costs that will be planned
169 for a given project/program, and, *funding* is the supply of money provided to accomplish a given
170 project/program. The risk source is based on the root cause of the risk, and, as such, only a
171 single source will cause a risk. The source is technical, schedule, or cost and not a combination
172 or all of these. This should not be confused with the consequence, which can be performance
173 (technical), benefit, cost, and/or schedule impact.

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FAA Programmatic Risk Management
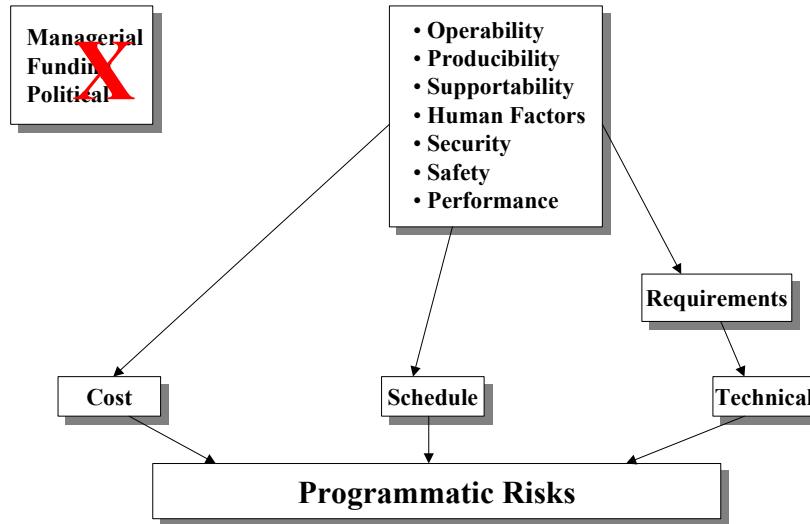Risk Identification Flow

Figure 4.10-5.

179

180 **Figure 4.10-5.**

181

182 For each risk area, many sources should be considered. For technical risk, likely sources
183 include technology maturity, complexity, dependency, stakeholder uncertainty, requirement
184 uncertainty, and testing/verification failure. Sources of schedule risks may include incomplete
185 identification of tasks, time-based schedule (as opposed to event-based schedule), critical-path
186 scheduling anomalies, competitive optimism, unrealistic requirements, and material availability
187 shortfalls. Cost risks may stem from an uncertain number of production units, supplier
188 optimism, additional complexity, change in economic conditions, competitive environment,
189 supplier viability, and lack of applicable historical data.

190 Table 4.10-2 provides the potential sources of risk to be considered in the process of program
191 risk assessment.

192 **Table 4.10-2. Potential Sources of Risk**

Potential Sources of Risk	
• Safety	• Test
• Security	• Verification
• Maintainability	• System Integration
• Reliability	• Staffing
• Supportability	• Tools
• Human Factors	• System Performance
• Availability	• Technology
• Decommissioning	• Planning

Potential Sources of Risk	
• Producibility	• Transition
• Commonality	• Environments
• Training	• Interdependencies (both FAA and non-FAA)
• Operations	

193

4.10.3.1.2. Risk Identification Methods

195 Risk identification begins at the lowest feasible level and normally includes inputs from all
196 stakeholders and suppliers. Anyone can identify a potential risk. Experts should review
197 programs to determine risks. Similar programs should be reviewed for determined risks as well
198 as actual problems. The objective of this step is to produce as comprehensive a list as possible
199 of potential risks. This may be achieved using any combination of methods, such as group
200 discussions, interviews, trend/failure analysis, risk templates, lessons learned, trade studies,
201 Best Practices, metrics, and acquisition documentation. The focus should be on root causes
202 and not on symptoms of a more basic problem. The problem must be defined at the lowest
203 level (root cause) so that the mitigation plan actually addresses the problem.

204 This process includes screening the list of risks for duplication and consolidation as appropriate.
205 Program Management errors are not risks and must be corrected before the program moves
206 forward. This screening considers program-level ramifications and should ensure that program
207 integration risks are adequately covered. A Risk Worksheet
208 (Figure 4.10-6) can be used to document newly identified potential risks.

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FAA Risk Worksheet

Program/Project Title_____   Seq. #: _____

Submitted by: _____   Date: _____

1 Risk:	2 Point of Contact

3 Source and Root Cause:

4	Risk Assessment			Rationale
o	Technical	o Schedule	o Cost	
	Likelihood	A B C D E		
	Consequence	1 2 3 4 5		

Likelihood (E D C B A) vs Consequence (1 2 3 4 5) risk matrix with High (red), Medium (yellow), Low (green).

Consequence Definition:

Risk Resolution Date:

5	Mitigation Options	Description	New Risk Level if Implemented
☐	Avoidance		H M L
☐	Transfer		H M L
☐	Control		H M L
☐	Assumption		H M L
☐	Research & Knowledge		H M L

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FAA Risk Worksheet

Program/Project Title_____ Seq. #: _____

Submitted by: _____ Date: _____

1 Risk:	2Point of Contact

3 Source and Root Cause:

4	Risk Assessment			Rationale
o	Technical	o Schedule	o Cost	
	Likelihood	A B C D E		
	Consequence	1 2 3 4 5		

Consequence Definition:

Risk Resolution Date:

5	Mitigation Options	Description	New Risk Level if Implemented
☐	Avoidance		H M L
☐	Transfer		H M L
☐	Control		H M L
☐	Assumption		H M L
☐	Research & Knowledge		H M L

227 **Figure 4.10-6.**

228 **4.10.3.2. Task 2: Analyze and Assess Impacts of Risk (Satisfies iCMM BP 13.03 criteria)**

229 Risk analysis assesses each component of an identified risk: (1) the likelihood that the risk will
230 occur and (2) the consequence to the program should it occur, as depicted in Figure 4.10-7.
231 The basic tool used for qualitative risk analysis is the risk template, which contains a set of
232 definitions to be used to evaluate the likelihood and consequence of a particular risk. The set of
233 templates that a program uses may change over time as new templates are added or existing

234 templates are changed, combined, or eliminated. The program may choose to use program-
235 unique templates (only if the technical elements of the program demand it), which are based on
236 program or stakeholder requirements, provided rationale is given. However, modification of
237 templates limits the ability to "roll-up" risks to a higher program level, and, as such, a
238 mechanism must be developed to correlate risks developed through modified templates to the
239 risks developed with the standard FAA templates. The program/project is responsible for the
240 choice, coordination, and control of the templates used on the program. These decisions are
241 contained in the Risk Management Plan section of the IPP (see Section 4.2.2.2 in Integrated
242 Technical Planning (Section 4.2)).

FAA Programmatic Risk Components

243

244 **Figure 4.10-7.**

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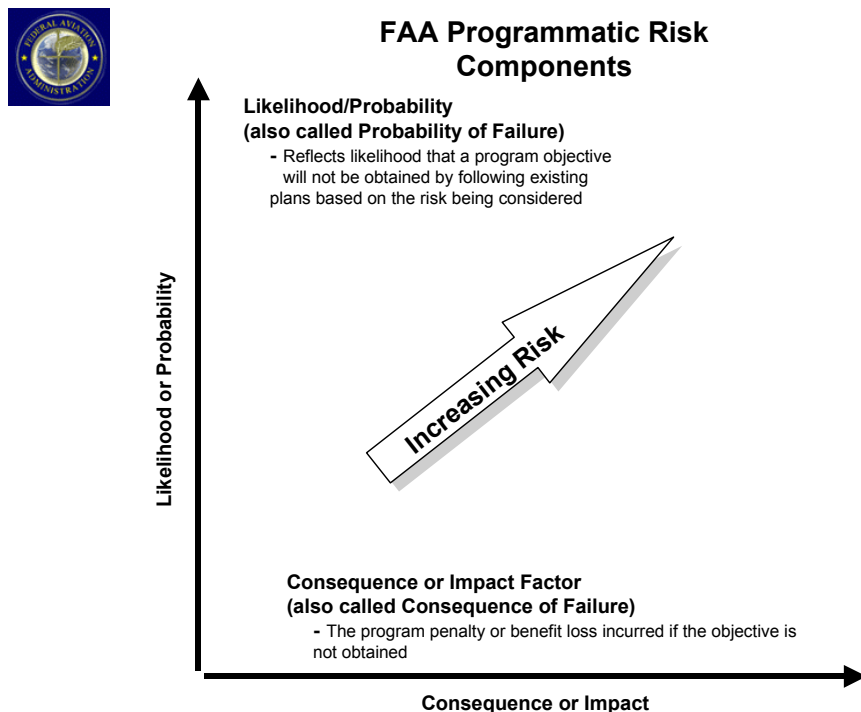
246 **4.10.3.2.1. Likelihood (Probability) Determination**

247 A likelihood (probability) template is developed that applies to the specific risk/program under
248 analysis. A new template is developed and documented if none of the existing program
249 templates are found to be applicable. This action must be coordinated within the
250 program/project using the criteria of the Risk Management Plan. Correlation of the new
251 templates to the standard FAA templates in this manual must be established. For interviews, a
252 Numerical Interpretation of Likelihood Descriptors matrix (Figures 4.10-8, 4.10-8A, and 4.10-8B)
253 can be used to translate words into numbers. The words are placed in random order on
254 Figure 4.10-8 such that the form can be used to generate a sample of stakeholder estimates of
255 probability. The terms have been placed in an ordered sequence in Figure 4.10-8A based on
256 an FAA early survey, and actual values from that survey are provided in Figure 4.10-8B. A
257 sample of a typical risk likelihood template is shown in Figure 4.10-9. Figure 4.10-10 provides
258 the FAA definitions of the risk likelihood levels.

259

260

Numerical Interpretation of FAA Likelihood Descriptors

(Exercise)

Statement

We doubt
We believe
Very good chance
Not likely
Probably not
Probably
Probable
Low Likelihood
Likely
Improbable
Highly unlikely
Highly likely
Chances are slight
Better than even
Almost no chance
Near certainty

0   10   20   30   40   50   60   70   80   90   100

Probability (%)

261

Figure 4.10-8.

Numerical Interpretation of FAA Likelihood Descriptors

(Exercise - 1)

Statement

Near certainty
Highly likely
Likely
Very good chance
Probable
Probably
We believe
Better than even
Probably not
We doubt
Low Likelihood
Improbable
Not Likely
Chances are slight
Highly unlikely
Almost no chance

0   10   20   30   40   50   60   70   80   90   100

Probability (%)

262

Figure 4.10-8A

263

Numerical Interpretation of FAA Likelihood Descriptors FAA Survey Results
(Exercise 2)

Statement

Statement	0	10	20	30	40	50	60	70	80	90	100
Near certainty											X
Highly likely										X	
Likely										X	
Very good chance										X	
Probable									X		
Probably								X			
We believe								X			
Better than even						X					
Probably not		X									
We doubt	X										
Low Likelihood	X										
Improbable	X										
Not Likely	X										
Chances are slight	X										
Highly unlikely	X										
Almost no chance	X										

Probability (%)

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Figure 4.10-8B.

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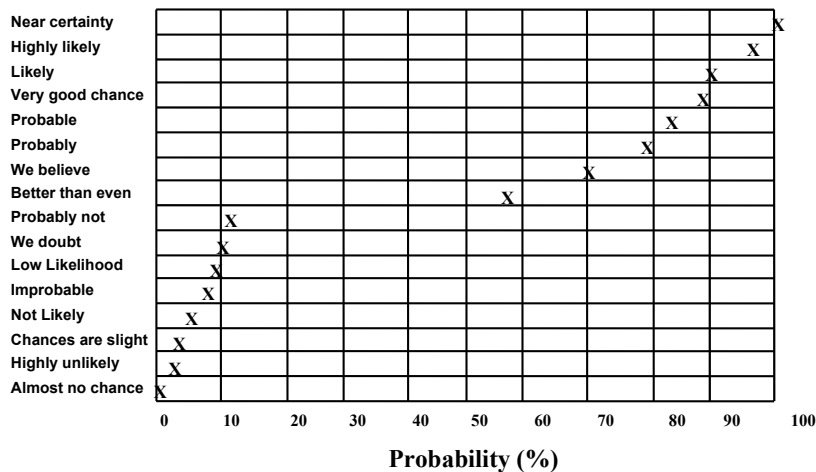
Typical Risk Likelihood Templates

Risk		Template		Likelihood				
Category	Nbr.	Name	Near Certainty (E)	Highly Likely (D)	Likely (C)	Low Likelihood (B)	Not Likely (A)
Complexity	1	Component Integration	Complex component interface based on new design	Complex component interfaces based on existing system	Typical component interfaces based on new design	Typical component interfaces based on existing design	No component interfaces or off-the-shelf
Dependency	2	Technology Dependence	Dependent on new technologies that are not yet funded	Dependent on new technologies that are in development	Dependent on innovative use of existing technologies	Minor modification of existing system	Off-the-shelf design
Experience	3	Key Personnel	Expertise not assigned	Core expertise only assigned to program	Core expertise assigned with other personnel available but not yet assigned	All required expertise assigned	All required expertise assigned with established refresher training program
Process Control	4	Processes	Processes are informal	Processes are partially documented and approved	Processes are largely documented and approved	Processes are in place and approved	Using standard processes with documented continuous improvement process
Maturity	5	Design Concept	New concept requires significant development	Proof of concept has been demonstrated	Similar concept exists on another program; able to meet requirements by analysis	Similar concept exists on another program; data is available showing compliance with requirements	Fully developed design that meets requirements

266

Figure 4.10-9.

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268 **4.10.3.2.2. Consequence Determinations**

269 Another set of templates is used to evaluate consequence/impact to the program should the risk
270 materialize. As was the case with likelihood templates, if none of the existing program
271 consequence templates are found to be applicable to a particular risk, new templates may be
272 developed and documented. Correlation of the new templates to the standard FAA templates in
273 this manual must be established. Consequence templates are shown for three areas of
274 program impact: technical (Figure 4.10-11), schedule (Figure 4.10-12), and cost
275 (Figure 4.10-13). It must be remembered that each of these results in a programmatic risk,
276 which threatens the benefits of a program and may also have interdependency impacts. All
277 NAS programs are developed to provide benefit(s) to the system. Programmatic risk ultimately
278 reflects in impacts to benefit(s). All benefit losses are derived from losses in either technical,
279 schedule, or cost risks. This is a significant part of the risk consequence that must be defined.
280 The cost/benefit analysis must be reexamined as a result of cost and/or benefit impacts to
281 provide the information needed to make program decisions.

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FAA Programmatic Risk Likelihood Definitions

What is the likelihood the risk will happen?

A. Low: Your approach and processes will effectively avoid or mitigate this risk based on standard practices.

The chance of a negative outcome based on existing plans is not likely. This likelihood level assessment should be based on evidence or previous experience and not on subjective confidence. This assessment level requires the approach and processes to be well understood and documented. Little or no management oversight will be required.

B. Minor: Your approach and processes have usually mitigated this type of risk with minimal oversight in similar cases.

There is a low likelihood but reasonable probability that a negative outcome is possible. Present plans include adequate margins (technical, schedule, or cost) to handle typical problems. This assessment level requires the approach and processes to be well understood and documented. Limited management oversight will be required.

C. Moderate: Your approach and processes may mitigate this risk, but workarounds will be required.

A negative outcome is likely, or the current approach and processes are only partially documented. Alternative plans or methods exist to achieve an acceptable outcome even if the risk is realized. Present plans include adequate margins (technical, schedule, or cost) to implement the workarounds or alternatives to overcome typical problems. Significant management oversight will be required.

D. Significant: Your approach and processes cannot mitigate this risk, but a different approach might.

A negative outcome is highly likely to occur, or the current approach and processes are not documented. While alternative plans or methods are believed to exist to achieve an acceptable outcome, there are not adequate margins (technical, schedule, or cost) to implement the workarounds without impacting the program management reserves in performance, schedule, or cost. Significant management involvement is required.

E. High: Your approach and processes cannot mitigate this type of risk; no known processes or workarounds are available.

A negative outcome is going to occur with near certainty. No alternative plans or methods have been documented. Alternatively, the risk item has yet to be evaluated adequately to be well understood, so there is a high level of uncertainty about the program success. Urgent management involvement is required.

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306

Figure 4.10-10.

FAA Technical Consequence Definitions

Given the risk becomes real, what would be the magnitude of the impact on system performance?

1. Low: Given that the risk is realized, there would be minimal impact.

    A successful outcome is not dependent on this issue; the technical performance goals will be met. There would be no impact on the success of the program.

2. Minor: Given that the risk is realized, there would be a minor performance shortfall but the same approach could be retained.

    The resulting technical performance would be below the goal but within acceptable limits. There would be no need to change the basic design, process, or approach. There would be no impact on the success of the program.

3. Moderate: Given that the risk is realized, there would be a moderate performance shortfall but workarounds would be available.

    The resulting technical performance would be below the goal. The basic design, process, or approach could be retained with only minor changes, and the overall system performance would still be acceptable as a result of workarounds such as the reallocation of functions or performance goals. There would be only a limited impact on the success of the program.

4. Significant: Given that the risk is realized, the performance would be unacceptable but workarounds would be available.

    The resulting technical performance would be unacceptably below the goal. The design, process, or approach would require a significant change to achieve an acceptable performance level. Additional workarounds such as the reallocation of functions or performance goals could also be required. The success of the program could be jeopardized.

5. High: Given that the risk is realized, the performance would be unacceptable with no known workarounds.

    The resulting technical performance would be unacceptably below the goal. There are no known alternatives or solutions. The success of the program would be in doubt.

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308   **Figure 4.10-11.**

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FAA Schedule Consequence Definitions

Given the risk becomes real, what would be the magnitude of the impact on the schedule?

1. Low: Given that the risk is realized, there would be minimal impact.

    The program schedule is not dependent on this issue. There would be no impact on the success of the program.

2. Minor: Given that the risk is realized, additional activities would be required to meet key dates.

    One or more key dates in the program schedule, but not critical path events, would be jeopardized; there are identified schedule workarounds that would be sufficient to mitigate the schedule impact. There would be no impact on the success of the program.

3. Moderate: Given that the risk is realized, there would be a minor schedule slip, and one or more need dates would be missed.

    One or more key need dates in the program schedule, but not critical path events, would be at least one month late; there are identified schedule workarounds that would be sufficient to keep the program critical path from being affected. There would be only a limited impact on the success of the program.

4. Significant: Given that the risk is realized, the program critical path would be affected.

    One or more events on the program critical path would be at least one month late. There are identified schedule workarounds that would be sufficient to meet major program milestones. The success of the program could be jeopardized.

5. High: Given that the risk is realized, a key program milestone cannot be achieved.

    Completion of a key program milestone would be late, and the success of the program would be in doubt. The slip requires a re-baseline of the program.

314

315 **Figure 4.10-12.**

316

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FAA Cost Consequence Definitions

Given the risk becomes real, what would be the magnitude of the impact on cost?

1. Low: Given that the risk is realized, there would be minimal cost impact.

   Program cost is not dependent on this issue. There would be no impact on the success of the program.

2. Minor: Given that the risk is realized, the total costs, operating cost or unit production cost would increase by = 1%.

   The program costs and/or the production unit cost would increase by = 1%. There would be no impact on the success of the program.

3. Moderate: Given that the risk is realized, there would be a minor increase in financial need. The program costs, operating cost or unit production cost could increase above 1% up to = 5%.

   The program costs and/or the production unit cost would increase above 1% to = 5%. There would be only a limited impact on the success of the program.

4. Significant: Given that the risk is realized, the total costs, operating cost or unit production cost would increase by above 5% to = 10%.

   The program costs and/or the production unit cost would increase above 5% to = 10%. The success of the program could be jeopardized.

5. High: Given that the risk is realized, the total costs, operating cost or unit production cost would increase by greater than 10%.

   The program costs and/or the production unit cost would increase by greater than 10%. The success of the program would be in doubt.

322

323 **Figure 4.10-13.**

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331 **4.10.3.2.3. Risk Level Determination**

332 The likelihood and consequence are considered to be independent, but tied to the same event,
333 and are mapped into a risk grid to determine the individual risk level (e.g., high (red), medium
334 (yellow), or low (green)) as shown in Figure 4.10-14. This mapping facilitates the prioritization
335 and trend analyses of risks throughout the life of the program. Use of a color code for each
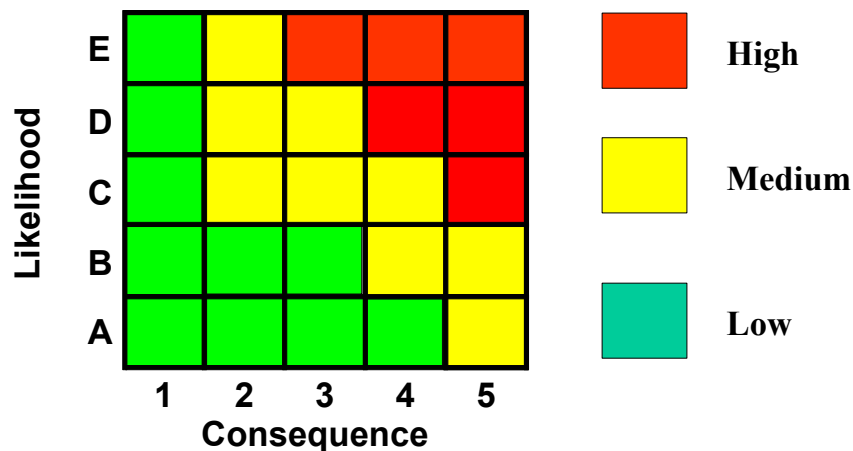
FAA Programmatic Risk Management

Risk Grid

336

337 **Figure 4.10-14.**

338

339 risk level supports effective communication of program health internally and externally.

340 Risk level definition high (red) is likely (a high probability) to cause significant disruption of
341 schedule, increase in cost, or degradation of performance. Concerted and continual emphasis
342 and coordination may not be sufficient to overcome major difficulties. Medium (yellow) may
343 cause some disruption of schedule, increase in cost, or degradation of performance. Special
344 emphasis and close coordination will probably be sufficient to overcome difficulties. Low
345 (green) has little potential for disruption of schedule, increase in cost, or degradation of
346 performance. Normal emphasis and coordination will probably be sufficient to overcome
347 difficulties. The threshold for differentiating between high, medium, and low may change from
348 program to program, but not for risk to risk, and should be determined early in the life of the
349 program.

350 Figure 4.10-15 is a summary of how the consequence and likelihood are consolidated to define
351 the risk level. Each risk must also be evaluated using the GAO (General Accounting Office)
352 process defined in Figure 4.10-16. At this point, it is necessary to make sure that the risk
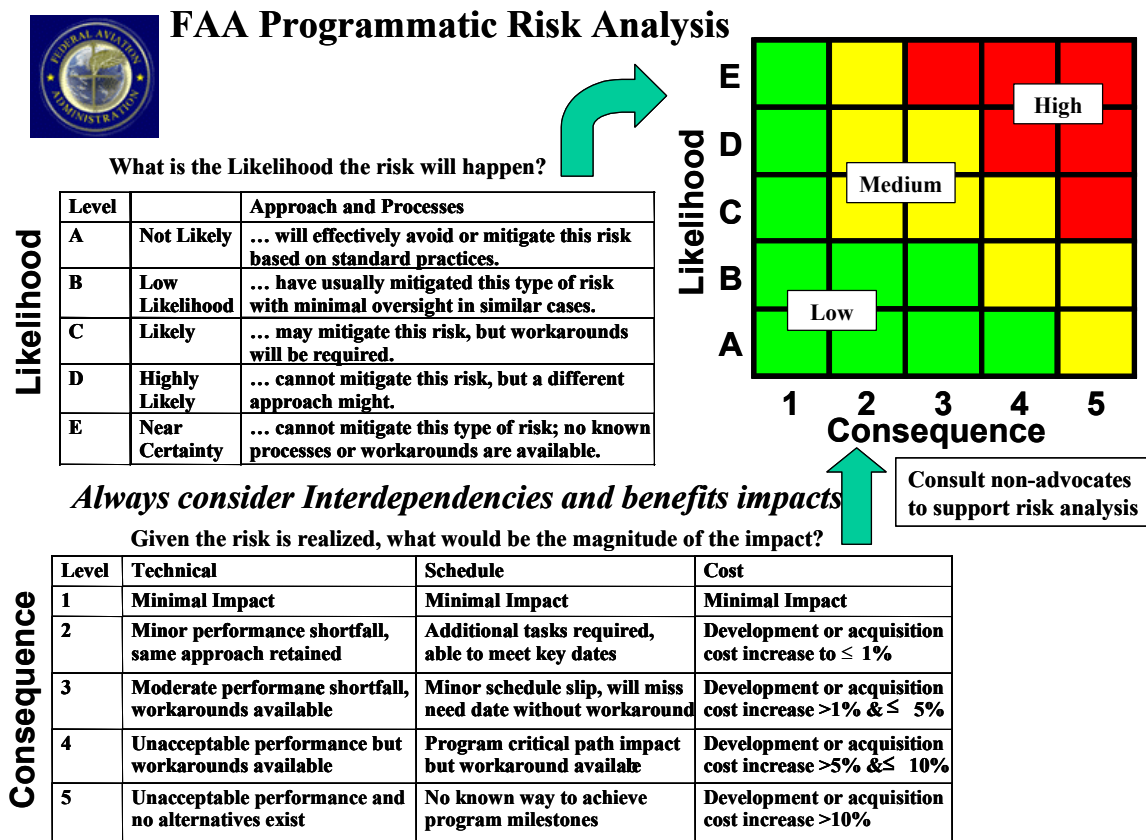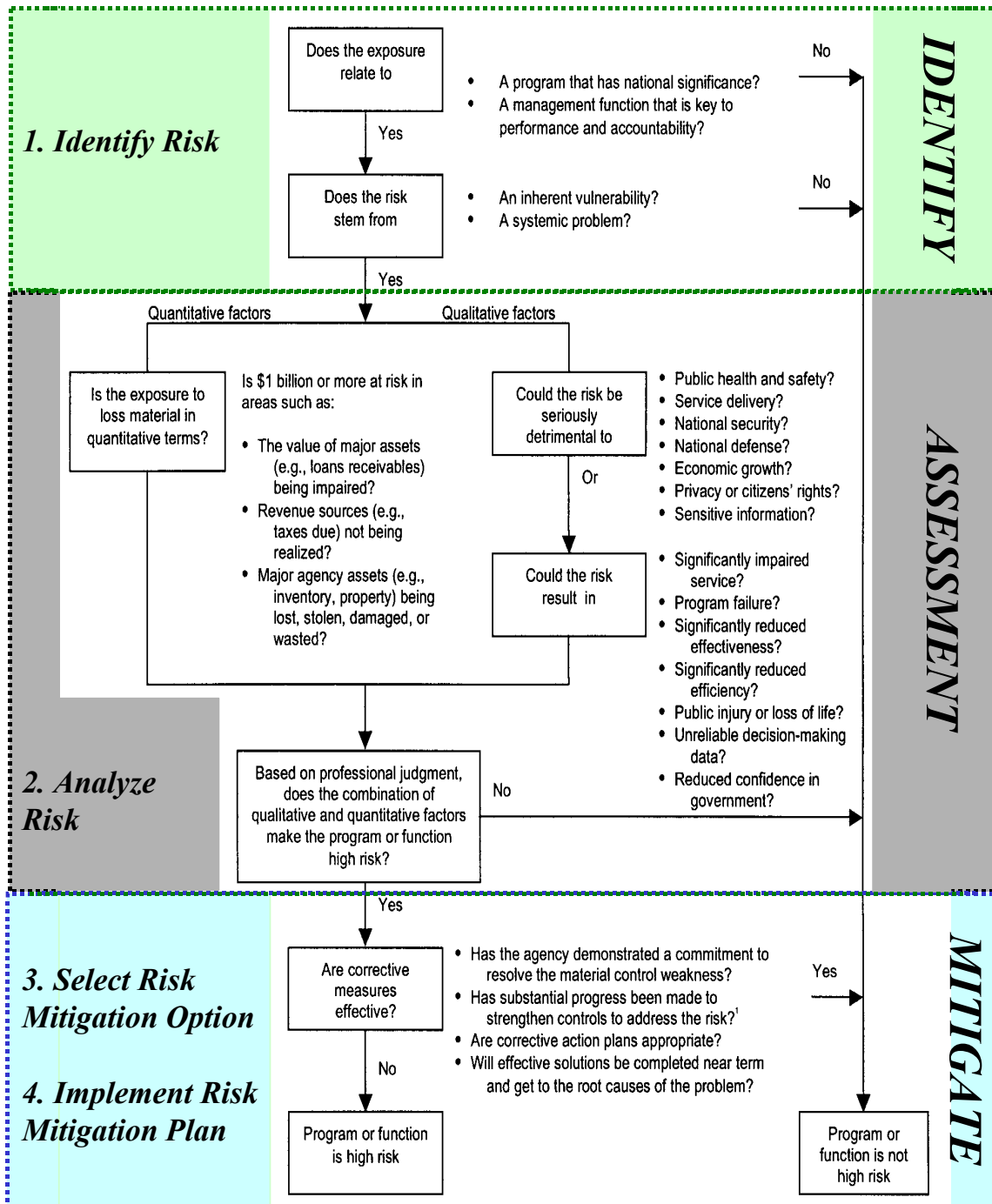353 resolution date is documented.

354

FAA Programmatic Risk Analysis

What is the Likelihood the risk will happen?

Likelihood

Level		Approach and Processes
A	Not Likely	… will effectively avoid or mitigate this risk based on standard practices.
B	Low Likelihood	… have usually mitigated this type of risk with minimal oversight in similar cases.
C	Likely	… may mitigate this risk, but workarounds will be required.
D	Highly Likely	… cannot mitigate this risk, but a different approach might.
E	Near Certainty	… cannot mitigate this type of risk; no known processes or workarounds are available.

Always consider Interdependencies and benefits impacts

Given the risk is realized, what would be the magnitude of the impact?

Consequence

Level	Technical	Schedule	Cost
1	Minimal Impact	Minimal Impact	Minimal Impact
2	Minor performance shortfall, same approach retained	Additional tasks required, able to meet key dates	Development or acquisition cost increase to ≤ 1%
3	Moderate performane shortfall, workarounds available	Minor schedule slip, will miss need date without workaround	Development or acquisition cost increase >1% & ≤ 5%
4	Unacceptable performance but workarounds available	Program critical path impact but workaround available	Development or acquisition cost increase >5% & ≤ 10%
5	Unacceptable performance and no alternatives exist	No known way to achieve program milestones	Development or acquisition cost increase >10%

Likelihood — E, D, C, B, A / **Consequence** — 1, 2, 3, 4, 5

High / Medium / Low

Consult non-advocates to support risk analysis

355

356 **Figure 4.10-15.**

357

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FAA Programmatic Risk Management

GAO Risk Assessment Process/Criteria

1. Identify Risk

Does the exposure relate to

Yes

Does the risk stem from

Yes

- A program that has national significance?
- A management function that is key to performance and accountability?

No

- An inherent vulnerability?
- A systemic problem?

No

IDENTIFY

Quantitative factors

Qualitative factors

Is the exposure to loss material in quantitative terms?

Is $1 billion or more at risk in areas such as:

- The value of major assets (e.g., loans receivables) being impaired?
- Revenue sources (e.g., taxes due) not being realized?
- Major agency assets (e.g., inventory, property) being lost, stolen, damaged, or wasted?

Could the risk be seriously detrimental to

Or

Could the risk result in

- Public health and safety?
- Service delivery?
- National security?
- National defense?
- Economic growth?
- Privacy or citizens' rights?
- Sensitive information?

- Significantly impaired service?
- Program failure?
- Significantly reduced effectiveness?
- Significantly reduced efficiency?
- Public injury or loss of life?
- Unreliable decision-making data?
- Reduced confidence in government?

2. Analyze Risk

Based on professional judgment, does the combination of qualitative and quantitative factors make the program or function high risk?

No

ASSESSMENT

Yes

3. Select Risk Mitigation Option

4. Implement Risk Mitigation Plan

Are corrective measures effective?

No

Program or function is high risk

- Has the agency demonstrated a commitment to resolve the material control weakness?
- Has substantial progress been made to strengthen controls to address the risk?[1]
- Are corrective action plans appropriate?
- Will effective solutions be completed near term and get to the root causes of the problem?

Yes

Program or function is not high risk

MITIGATE

GAO process requires examination of risk and the development of a mitigation effort. Shown is Figure 5 of GAO/OCG-00-12, Page 9. (August/2000).

369

370

Figure 4.10-16.

371   **4.10.3.3. Task 3: Select Risk Mitigation Option** *(Satisfies iCMM BP 13.05 criteria)*

372   Risk mitigation requires a conscious management decision to approve, fund, schedule, and
373   implement one or more risk mitigation actions. Risk mitigation plans and mitigation actions are
374   reviewed frequently at major reviews, program reviews, acquisition reviews, and milestone
375   reviews. The objective of the risk mitigation step is to implement appropriate and cost-effective
376   risk mitigation plans to mitigate or eliminate the risks. Appropriate risk mitigation techniques are
377   selected, and mitigation actions are developed, documented, and implemented. The risk
378   mitigation plan/implementation and tracking are the core of risk management.

379   Risk mitigation actions fall into one, or a combination, of the following categories
380   (Figure 4.10-4):

381   • Avoidance

382   • Transfer

383   • Control

384   • Assumption

385   • Research and Knowledge

386   "Avoidance" is a strategy to avert the potential of occurrence and/or consequence by selecting a
387   different approach or by not participating in the program. This technique may be pursued when
388   multiple designs or programmatic options are available. It is more likely used as the basis for a
389   "Go"/"No-Go" decision at the start of a program. Some examples are selection of state-of-the-
390   practice rather than state-of-the-art technologies and prequalification of suppliers. The
391   avoidance of risk is from the perspective of the overall program/project, which includes the
392   stakeholders, contractors, and execution groups. Thus, an avoidance strategy is one that
393   involves all of the major parties to the program/project and permits a program/project-wide
394   avoidance of the risk.

395   "Transfer" is a strategy to shift the risk to another area, such as another requirement, an
396   organization, a supplier, or a stakeholder. Examples include reallocating of requirements,
397   securing supplier product warranties, and negotiating of fixed-price contracts with suppliers.
398   Note that at the program level the risk remains. The transfer of the risk is accomplished
399   primarily to optimize, in a sense, the overall program risk and to assign ownership to the party
400   most capable of reducing the risk. It is possible that the risk level will change as a result of the
401   risk transfer.

402   "Control" is a strategy of developing options and alternatives and taking actions that lower or
403   eliminate the risk. Examples include new concepts, more analysis, redundant systems and/or
404   components, and alternate sources of production.

405   "Assumption" is simply accepting the likelihood/probability and the consequences/impacts
406   associated with a risk's occurrence. Assumption is usually limited to low risks. This is a
407   program/senior management option, not a program option. FAA practice is to develop
408   mitigation plans for all medium and high risks.

409   "Research and Knowledge" may mitigate risk through expanding research and experience.
410   Since risk arises from uncertainty and inexperience, it may be possible to effectively mitigate
411   risk simply by enlarging the knowledge pool, leading to reassessment that reduces the
412   likelihood of failure or provides insight into how to lessen the consequences.

413   At this point, several alternatives for mitigating the risk have been identified and analyzed for
414   selection of the preferred approach. Alternatives include detailed plans for mitigating the risk in

415 several small, sequential steps; alternative steps; or entirely new (non-baselined) approaches to
416 accomplishing the program. Further, contingency plans are identifiable alternatives that can be
417 implemented if a mitigation plan fails, and the risky event or conditions occur with more serious
418 consequences than anticipated. The mitigation steps are the major milestones of the mitigation
419 plan. Contingency plans need not be extremely detailed.

420 Trade study techniques can be performed to help select the preferred risk mitigation plan.
421 While the proper criteria and their weights for each analysis are dependent on the risks to be
422 mitigated, the following should be included:

423 • Does the option mitigate the likelihood or consequence of the risk?

424 • Does the option fit within program scope?

425 • Is the option easy to implement?

426 • Are new risks avoided or introduced?

427 • What is the cost of mitigation?

428 • What is the schedule for mitigation?

429 The risk level is the first criterion used to determine the need for a risk mitigation plan. Program
430 risks that fall into the medium or high categories require risk mitigation plans. Risks that are
431 assessed as low typically do not require mitigation plans but may have certain aspects that
432 would be prudent to monitor. If this is the case, risk mitigation plans may be formally or
433 informally implemented for these low-risk issues based on the specific Risk Management Plan
434 for a program.

435 It is essential that those responsible for plan implementation have a thorough understanding of
436 the risk to be mitigated. This can be accomplished with a good summary statement of the risk.
437 It should include descriptions of the future event or condition, which confirms trouble for the
438 program; the root cause(s) of the event outcome or conditions; and the specific effects to the
439 program if the event or conditions occur with negative consequences. The risk should not be
440 stated in terms of its mitigation plan.

441 The status should also include a summary of risk mitigation efforts that references more detailed
442 documentation. A Risk Mitigation Plan Summary (Figure 4.10-17) is used to report the analysis
443 and actions on an individual risk.

444 The risk mitigation plan documents the specific steps to be implemented, the sequence in which
445 they will be implemented, and the points in time at which they will be implemented.
446 Development of a risk mitigation plan includes an assessment of the expected outcome
447 following implementation. The same method initially used to assess the risk, such as risk
448 templates, should be used to provide a forecast of the risk level after completion of each action
449 of the risk mitigation plan. The expected impact of each mitigation event on risk level can be
450 projected using a format similar to that of Figure 4.10-18 (a "waterfall chart").

451

452

453

Risk Mitigation Plan Summary

Page ____ of ____

Status: _____

Risk Title

Program/Project

Project Lead

Description of Risk

Statement of Root Cause

Consequence if Realized

Risk Type: **T   S   C**

Likelihood ____

Consequence ____

Comments:

Risk Resolution Date:

Place X in One Cell

Likelihood: E D C B A

Consequence: 1 2 3 4 5

Risk Mitigation

	2002											2003											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
HIGH																								
MEDIUM																								
LOW																								
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

454

Figure 4.10-17.

456

Risk Mitigation Waterfall Schedule
Sample

	3032												3033						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
HIGH		Mitigation Action 1																
				Mitigation Action 2														
MEDIUM										Mitigation Action 3								
LOW		Current Date																
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J

457

Figure 4.10-18.

459   The risk management plan becomes the basis for monitoring the success in mitigating each
460   risk. The plan includes, but is not limited to, the following:

461   • A description of the risk for which the plan applies

462   • The mitigation approaches that detail the specific actions that are planned to reduce the
463   risk or eliminate it. These actions should be event-based, integrated into a schedule,
464   and have associated with each of them:

465   − The decision point or trigger, past or future, that initiates the action or group of
466   actions

467   − The resources required to execute the actions (including personnel, capital
468   equipment, facilities, procured equipment)

469   − The measures of success to be used for the planned actions or group of actions

470   − The fallback options (if any)

471   − The planned completion dates of the actions

472   • Risk mitigation metrics

473   • The Risk Worksheet (Figure 4.10-6)

474   • Risk Mitigation Waterfall Schedule (Figure 4.10-18)

475   • The initial Risk Mitigation Plan Summary (Figure 4.10-17)

476   A risk mitigation plan should be evaluated to determine its effectiveness. This analysis is
477   performed in the same manner as initial analysis for the risk. The set of templates used for
478   analysis of the risk can also be used to determine the mitigation in the risk level following the
479   completion of each major action or group of actions. The regular reassessment of the risk and
480   performance to plan using a fixed set of criteria provides a consistent analysis of the impact to
481   the program.

482   When a risk mitigation plan has been prepared, it is reviewed and approved by stakeholders
483   based on criteria defined in the Risk Management Plan.

484   **4.10.3.4. Task 4: Implement Risk Mitigation Plan** *(Satisfies iCMM BP 13.05 criteria)*

485   Once a mitigation plan option is selected, the Risk Mitigation Plan Summary chart
486   (Figure 4.10-17) is used as a means of reporting progress in mitigating risks. An example is
487   provided in Figure 4.10-17A. The black, broken line on the stairsteps indicates the planned
488   level of risk versus time; the planned events for reducing the risk are shown as arrows with text
489   boxes. Each major event in the mitigation plan is identified together with how that event
490   mitigates the risk and to what level.

491   Risk mitigation plans are implemented with the actions and milestones being incorporated in the
492   planning, scheduling, budgeting, and cost accounting systems used on the program.
493   Incorporation of the risk mitigation plans and milestones into these program processes and
494   systems ensures that the risk and its mitigation plans will be monitored and tracked until the risk
495   is eliminated or the risk requires program modification. Risk mitigation plans can be
496   documented starting with the Risk Worksheet shown in Figure 4.10-6 and a Risk Mitigation
497   Waterfall Schedule shown in Figure 4.10-18. All mitigation activities are shared with and
498   communicated to all stakeholders.

499

500
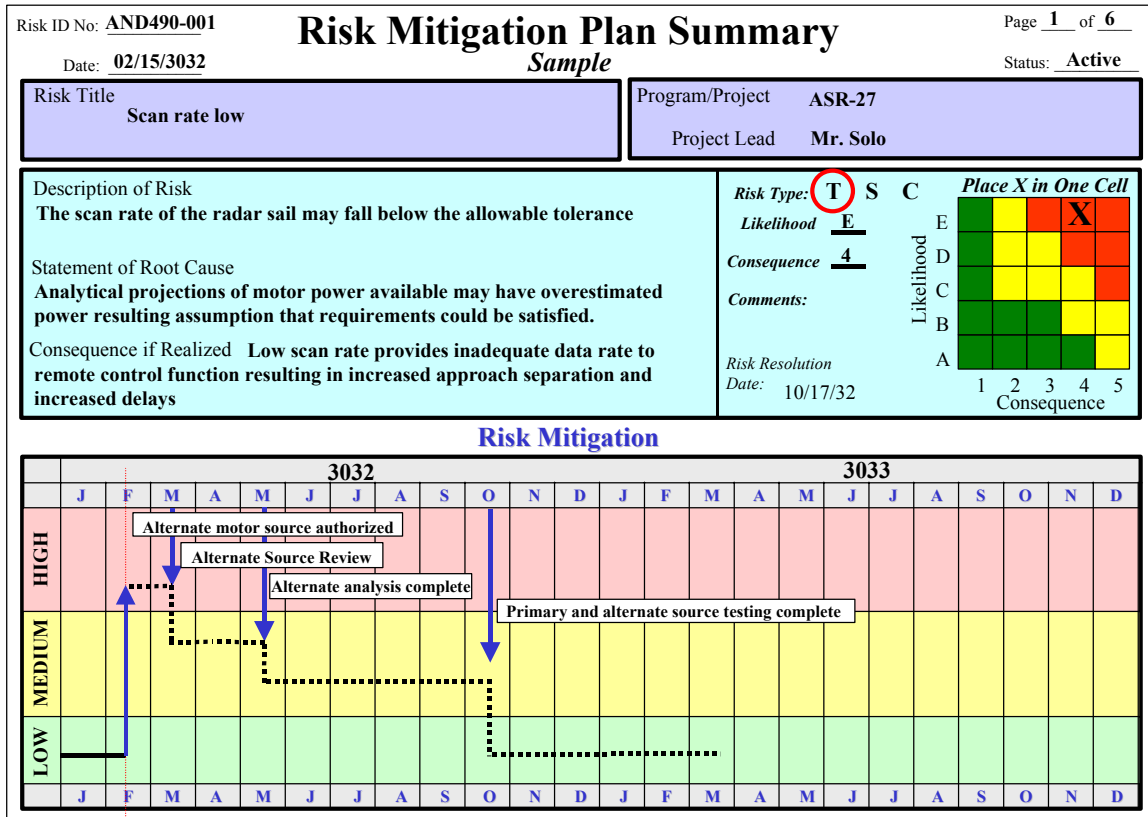
Figure 4.10-17A.

4.10.3.5. Task 5: Monitor and Track Risks *(Satisfies iCMM PA 14 criteria)*

Reassessment of currently managed risks is done on a periodic and event basis to reflect current status of the issues as well as to identify and quantify new and emerging issues. New, potential risks to the program may be identified at any time. Newly identified risks are analyzed using the same steps described in Section 4.10.3.2.

Steps in the risk-tracking process focus on providing the execution teams, interdependent activities, and program management with program risk trends and status. Actual performance of the planned mitigation actions is compared to the expected performance. The bold line on the Risk Mitigation Plan Summary "waterfall area" (Figure 4.10-17B) indicates progress made to date on the mitigation plan. Detailed cost and schedule tracking is done as part of the program schedule and cost- tracking system.

Figure 4.10-17B.

4.10.3.5.1. Documentation of Risk Analyses

Following the initial risk assessment and each subsequent assessment, the analysis results are documented. The form shown in Figure 4.10-6 is a recommended Risk Worksheet used for documentation. The risk mitigation plan area can be left blank until the risk mitigation plans are completed. When a risk item has been identified, it is incorporated into the risk register (see Figure 4.10-19 and example in Figure 4.10-19A), which includes the program name, revision date, and page sequence.

The risk register is a listing of risk information associated with achieving program objectives. In addition to the risk registers created and maintained by each project, a single composite register of all interdependency risk items must be developed for the program. These registers will be consistently used to monitor and track overall risk status within team meetings, program management reviews, and major program reviews. Immediately following the identification and analysis of a new medium or high risk or when a significant change occurs in a previously identified risk, changes must be incorporated in the register and other documents and the new risk identified to stakeholders. The distribution list will be established by a program's Risk Management Plan. Computer database systems may be needed to manage these outputs for large programs. Smaller programs will often be able to use desktop computer techniques.

FAA Program Risk Register

DATE mm/dd/yyyy
Page _____ of _____
Revision

Risk #	Likelihood	Consequence	Risk Level/Change	Risk Item/Consequence	Next Milestone date	Risk Resolution Date	Mitigation Status	Risk Type
1								
2								
3								

Consequence Key:
1= Minimal impact
2= Minor, able to maintain same approach
3= Moderate shortfalls, workaround exists
4= Unacceptable, workaround exists
5= Unacceptable, no alternative exists

Risk Level:
H - High   **M** - Medium   **L** - Low
➤= same as last report   ▲= up from last report
▼= down from last report

Risk Type:
Ⓣ - Technical
Ⓢ - Schedule
Ⓒ - Cost

540

541   **Figure 4.10-19.**

FAA Program Risk Register

(Example)

DATE 04/15/**3032**
Page __1__ of __1__
Revision

Risk #	Likelihood	Consequence	Risk Level/Change	Risk Item/Consequence	Next Milestone date	Risk Resolution Date	Mitigation Status	Risk Type
1	D	3	M ▼	Sweep rate low/ delays-benefits loss	30320515	30321017	On Track	T
2								
3								

Consequence Key:
1= Minimal impact
2= Minor, able to maintain same approach
3= Moderate shortfalls, workaround exists
4= Unacceptable, workaround exists
5= Unacceptable, no alternative exists

Risk Level:
H - High   **M** - Medium   **L** - Low
➤= same as last report   ▲= up from last report
▼= down from last report

Risk Type:
Ⓣ - Technical
Ⓢ - Schedule
Ⓒ - Cost

542

543   **Figure 4.10-19A.**

544

545

546   At minimum, the following information shall be included in the risk register:

4.10.3.5.1.1.   Risk Register Identification and Creation/Update Date

548   This is the name of the program risk item. Include the root cause of the risk in this section.

4.10.3.5.1.1.1. Risk Identification Number

550   This number is the code that identifies a unique sequence.

4.10.3.5.1.1.2. Likelihood

552   This is a figure-of-merit indicating the relative likelihood/probability that the identified risk will
553   actually occur (Likelihood Template, Figures 4.10-9 and 4.10-10).

4.10.3.5.1.1.3. Consequence

555   This is a figure-of-merit indicating the relative severity of consequences/impacts that could result
556   if the identified risk did occur (Consequences Templates, Figures 4.10-11, 4.10-12, and 4.10-13,
557   for examples).

4.10.3.5.1.1.4. Risk Level/Change

559   This is a single letter indicating the assessed risk of an item as high, medium, or low (H, M, L)
560   or, red, yellow, or green (R, Y, G), respectively. An arrow that indicates the direction that the
561   risk has moved since the last revision to the risk register demonstrates the risk change.

4.10.3.5.1.1.5. Risk Consequence Description

563   This is a brief, well-stated description of the risk's negative consequences is listed.

4.10.3.5.1.1.6. Next Milestone Date

565   This date is the projected date on which the risk level converts to lower risk. This will be
566   traceable to the Risk Mitigation Plan Summary (See Figure 4.10-17).

4.10.3.5.1.1.7. Risk Resolution Date

568   This is the date of the event that will occur that will either make the risk a real part of the
569   program or eliminate the need to track the risk. Early in the program, it may be difficult to
570   predict an exact date, but a general timeframe needs to be developed. As the program
571   matures, date resolution should occur. These dates should be reviewed regularly and be on the
572   program master schedule.

4.10.3.5.1.1.8. Mitigation Status

574   The currently planned mitigation actions are defined.

4.10.3.5.1.1.9. Risk Type

576   The risk type designates if the risk is a cost risk, a schedule risk, or a technical risk (see
577   paragraph 4.10.3.1.1).

4.10.3.5.2.   Risk Mitigation Plan Status

579   The teams regularly update and report the status of the risk mitigation plan for each risk being
580   tracked. Actions are initiated as required where mitigation plan activities are not being
581   accomplished. The risk status is also reviewed with program management on a regular basis.
582   A sample of a brief summary of all risks for a particular program (or team) is shown in a
583   Program Risk Summary (Figures 4.10-20 and 4.10-20A) for use depending on program size.
584   Risk mitigation progress is shown in a Program Risk Mitigation Progress chart   (Figures 4.10-
585   21 and 4.10-21A).
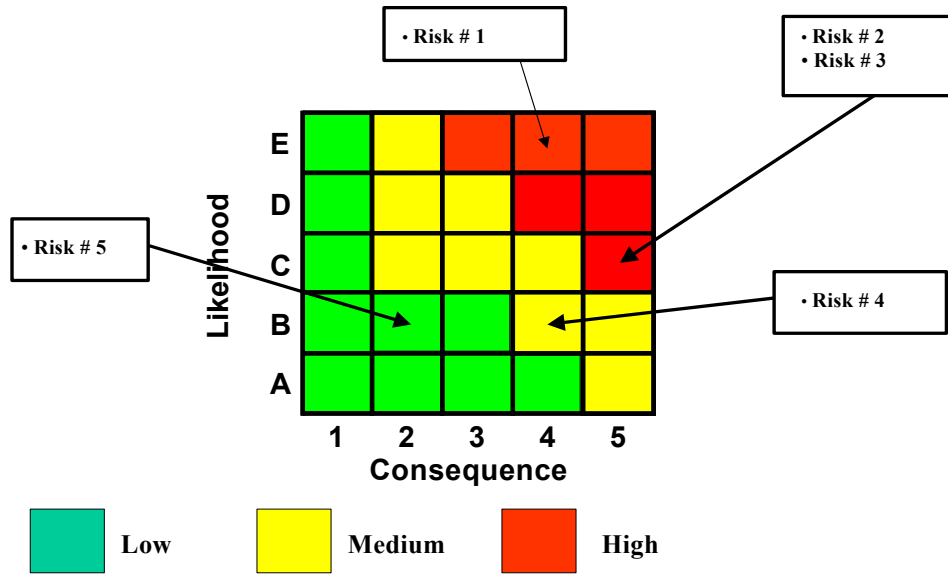
Program Risk Summary
Sample few risks

Low   Medium   High

586

587   **Figure 4.10-20.**

Program Risk Summary
Sample many risks

Low   Medium   High

588

589   **Figure 4.10-20A.**

590
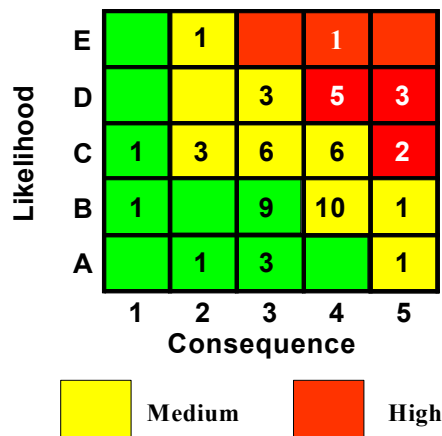
Sample
Program Risk Mitigation Progress

591
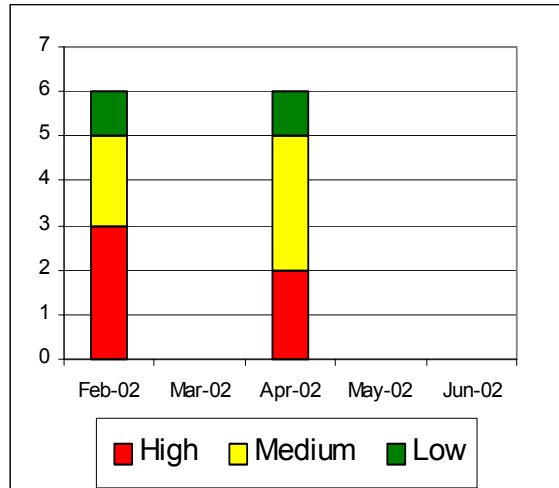
592   **Figure 4.10-21.**

593

594

FAA Programmatic Risk Management
NEXCOM Example
Summary of Risks
Last risk assessment conducted in January 2000.

Impact: A subjective ranking from 1 to 5.

1 = very low
2 = low
3 = moderate
4 = high
5 = very high

Probability: An estimate that the risk will occur during the impact time. A subjective ranking from 1% (extremely unlikely) to 99% (almost certain)

595

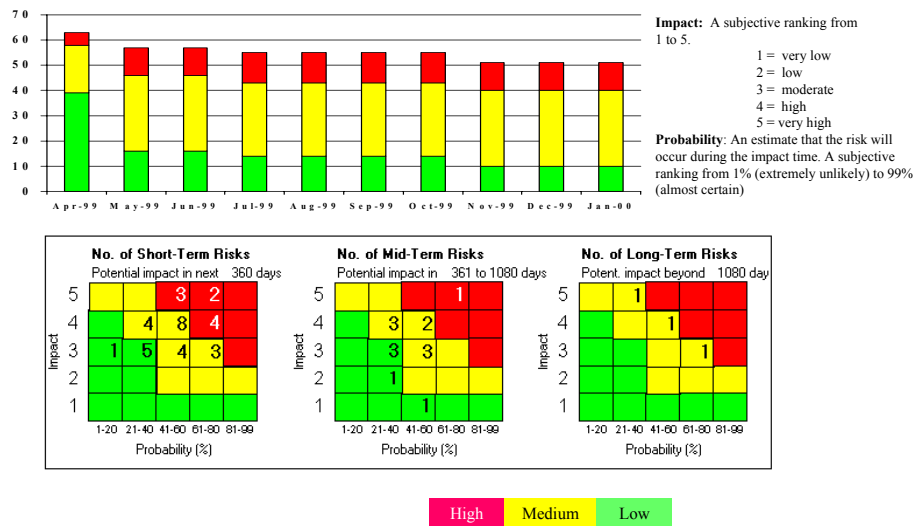596   **Figure 4.10-21A.**

597 **4.10.4. Outputs of Risk Management (Satisfies iCMM Artifacts criteria)**

598 The five major outputs of this process are:

599 • Program Risk Register (Figure 4.10-19)

600 • Risk Mitigation Plans (Section 4.10.3.3)

601 • Program Risk Summary (Figures 4.10-20 and 4.10-20A)

602 • Program Risk Mitigation Progress Chart (Figures 4.10-21 and 4.10-21A)

603 • Risk Mitigation Plan Summary (Figure 4.10-17)

604 The Program Risk Summary, the Risk Mitigation Plan Summary, and the Program Risk
605 Mitigation Progress charts should be briefed at all regular program reviews. Management
606 decisions are based on the above information. A complete status of a given risk should be
607 briefed when the risk is identified and immediately following the risk resolution date.

608 The Risk Mitigation Plan should be considered an appendix to the IPP and Acquisition Program
609 Baseline. It must be handled as an integral part of program effort.

610 **4.10.5. Risk Management Tools**

611 The tools needed to implement this process include:

612 • Likelihood and consequence templates tailored for the program

613 • A means to document the results of the process and manage the outputs (databases,
614   spreadsheets, word processors, etc.)

615 • A means to communicate results across a program (electronic mail, servers, etc.).

616 Database tools such as "Risk Radar" –(a tool free to the government (http://www.spmn.com)))
617 can be used to generate many of the risk work products (see Section 4.10-7). Analytic tools can
618 be used for probabilistic analysis of schedule uncertainty or technical uncertainty. Critical Path
619 Analysis tools can be used with the program's Integrated Master Schedule to regularly evaluate
620 schedule risk. In a similar fashion, commercial applications (e.g., @RISK) can be applied to
621 technical parameters (such as weight, latency, power, computer throughput) to establish
622 confidence ranges. Results from these probabilistic analyses can support the overall risk
623 analysis task of establishing a likelihood of occurrence. Further details on the use of
624 probabilistic analysis can be found in textbooks and technical papers that cover statistical
625 analysis for risk management.

626 **4.10.6. Risk Management Process Metrics (Satisfies iCMM PA 18 criteria)**

627 Metrics for the Risk Management process can include:

628 • Total risks identified; total high risks, total medium risks

629 • Percent of risks (Medium and High) with approved mitigation plans

630 • Percent of mitigation actions that provide expected reduction in risk level

631 • Percent of total risks reduced to Low in the planned amount of time

632 • Number of unplanned/unidentified negative consequence events

633 • Risk mitigation schedule and budget compliance.

634 Metrics for each program will be defined as part of the Risk Management Plan.

635 **4.10.7. References**

636 1. AFMC. "Acquisition Risk Management Guide." USAF Pamphlet 63-101.

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